REMARKS/ARGUMENTS

Claims 1-21 were pending all of which stand rejected. Claims 1, 2 and 4-6 have been amended and new Claims 22-26 have been added.

Claims 1-6, 11, 12, 14-16 and 18-21 were rejected under 35 U.S.C. §103(a) as being unpatentable over the combination of Xia et al., Ngo et al. and Yokoshima. The Examiner cited Xia et al. as disclosing a method for removing fluorine residue in a process chamber by supplying a hydrogen-containing gas into the chamber but admitted that Xia does not disclose supplying an oxygen-containing gas to the chamber. To fill this gap, the Examiner cited Ngo et al. and Yokoshima.

The Applicants submit that Xia et al. cannot be combined with Ngo et al. and Yokoshima in the manner proposed by the Examiner.

Xia et al. are cited by applicants, the relevant teaching of Xia et al. is described in the application as follows:

> "This method dissociates a fluorine containing gas such as NF_3 in a remote plasma source and then introduces the dissociated gas into the chamber to clean residues from the interior chamber surfaces. NH_3, H_2 and/or SiH_4 are then introduced into the chamber to remove fluorine residue remaining from the prior step." (Page 3, lines 10-15)

Ngo et al. have nothing whatever to do with the cleaning of the interior surfaces of a deposition process chamber. Rather, the process described by Ngo et al. "addresses and solves the side surface corrosion problem encountered in patterning and gap filling closely spaced apart metal lines," in particular "metal lines in semiconductor devices having a design rule of about 0.18 micron and under." (Col. 2, lines 51-52; col.3, lines 49-51)

In the process described by Ngo et al.,

> "a composite metal is conventionally patterned into a plurality of metal features, e.g., conductive lines, employing anisotropic etching, typically with fluorine and /or chlorine chemistry. Subsequent to etching, a wet cleaning procedure is conducted in an attempt to remove etching residue. Such conventional wet cleaning typically comprises treatment with a solvent . . . . [A]s the design rule is scaled down to 0.18 micron and under, it is extremely difficult to effectively remove etching residues formed during patterning. Such etching residues are believed to attack the side surfaces of metal features and form voids." (Col. 2, lines 13-27)

Ngo et al.'s solution to this problem is "treating the patterned metal layer with a plasma containing: (a) ammonia; or (b) ammonia and oxygen" (col. 3, lines 10-11).

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The Examiner claims that "[i]t would have been obvious to one of ordinary skill in the art to add oxygen to the ammonia for plasma etching in the method of Xia because Ngo . . . teach that it is useful to add oxygen to ammonia for plasma etching." This conclusion cannot be supported.

Xia et al., as relevant here, teach "a method [which] provides gettering of any adsorbed clean gases, such as fluorine, from the surface of chamber walls" (col. 9, lines 20-22). The method involves the use of SiH_4 (silane), active hydrogen or ammonia (col. 59, lines 10, 30, 56). In contrast, Ngo et al. do not teach that their mixture of "ammonia and oxygen" is useful in removing fluorine. Rather, Ngo et al. merely state that a "fluorine and/or chlorine chemistry" is used to etch the metal, that a "wet cleaning procedure" is used to remove the etching residue, and that a mixture of ammonia and oxygen can be used to remove "residues from preceding steps, e.g., etching and/or wet cleaning" (col. 5, lines 7-8). Ngo et al. do *not* teach that the mixture of ammonia and oxygen is effective in removing a fluorine residue. In fact, they admit that they do not even know how their process works or which residues are removed:

> "The exact mechanism underpinning the advantageous reduction in corrosion of the side surfaces of the metal feature and voiding , such as stress corrosion induced voiding, is not known with certainty. However, it is believed that treatment with an ammonia- or ammonia and oxygen-containing plasma effectively removes any residues formed as a result of *etching and/or wet cleaning*, thereby avoiding corrosive attack of the side surfaces of the metal feature." (Emphasis added.) (Col. 4, lines 11-19)

Ngo et al. teach a method of removing residues that are formed as a result of "etching and/or wet cleaning." Claim 1, as amended, recites "creating a fluorine-containing plasma in said chamber, said fluorine-containing plasma leaving a fluorine-containing contaminant on said interior surface." There would be no assurance the technique of Ngo et al. for removing a residue formed from "etching and/or wet cleaning" would be effective in removing a "fluorine-containing contaminant" resulting from a "fluorine-containing plasma."

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This conclusion is underscored by the disclosure in the subject application. Fig. 5, for example, indicates that the volume of HF removed by a plasma that includes a hydrogen-containing gas alone (NH_3) is an order of magnitude less than the volume of HF removed by a plasma that includes a combination of an oxygen-containing gas (O_2) and a

hydrogen-containing gas (NH_3). Clearly, the hydrogen-containing plasma alone is not effective. An yet Ngo et al. teach that *either* an ammonia- *or* an ammonia and oxygen-containing plasma may be used effectively. This strongly suggests that the residues that they Ngo et al. are concerned with are not the "fluorine-containing contaminant" recited in Claim 1.

In view of these distinctions, a person skilled in the art, upon reading Ngo et al., would not be motivated to add oxygen to the hydrogen-containing gases taught by Xia et al. for the specific purpose of removing a fluorine-containing contaminant, nor would such a person have a reasonable expectation that adding oxygen to a hydrogen-containing gas would assist in the removal of a fluorine-containing contaminant. These elements are necessary to support an obviousness rejection. See M.P.E.P. § 2143.02. The essential nexus between these two references is missing.

Moreover, Ngo et al. are concerned with removing residues from the "side surfaces" of metal features in semiconductor devices manufactured under a design rule of 0.18 micron or less. Xia et al., as pertinent here, are concerned with the "gettering of any adsorbed clean gases, such as fluorine, from the surface of chamber walls" (col. 9, lines 21-22). These processes thus operate on completely different scales, and there could be no reasonable expectation that a process useful in the sub-micron scale would be effective in cleaning the interior walls of a deposition chamber.

The Examiner states that "Yokoshima suggests that the addition of oxygen to ammonia during plasma etching is useful to order to control the amount of nitrogen, as well as to serve as a diluent (col. 4, lines 4-24)." This is not correct. Yokoshima teaches a process (step S2) for removing a "dopant-containing residue" of a photoresist layer from a processing article (col. 3, lines 29-31). The process uses a gas "containing at least one of fluorine and hydrogen, specifically carbon fluoride, nitrogen fluoride, ammonia, sulfur fluoride, fluorine, hydrogen and water" (col. 3, line 65, to col. 4, line 1). Yokoshima teaches that oxygen may be added to the process gas.

> "Oxygen has not only a function of serving as a diluent gas, but also a function of reacting with *carbon or nitrogen* generated from carbon fluoride, nitrogen fluoride or ammonia to form carbon dioxide gas or nitrogen oxide gas thus removing *remaining carbon or remaining nitrogen* from a processing space quickly." (Emphasis added.) (Col. 4, lines 4-9)

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Yokoshima thus does not teach the addition of an oxygen-containing gas to a hydrogen-containing gas as a means of removing a *fluorine-containing contaminant*. Rather, Yokoshima teaches the addition of oxygen to a fluorine- or hydrogen-containing gas as a mean of removing *carbon or nitrogen*. This is entirely irrelevant to the process taught by Xia et al. Yokoshima cannot be combined with Xia et al. in the manner proposed by the Examiner.

Moreover, Claim 1, as amended, does not refer to nitrogen, and consequently nitrogen is not relevant to the process recited in Claim 1.

Claim 1 has been amended to define even more clearly over the cited references. As a result, Claim 1 now recites "depositing a film on said substrate, said depositing leaving a deposition residue on an interior surface of said chamber," "cleaning said deposition residue from said interior surface by creating a fluorine-containing plasma in said chamber, said fluorine-containing plasma leaving a fluorine-containing contaminant on said interior surface" and "producing a plasma of a mixture of the oxygen-containing gas and the hydrogen-containing gas, so that the plasma reacts with the fluorine-containing contaminant to form a fluorine-containing material." Claim 1 as amended clearly distinguishes over the teachings of Xia et al., Ngo et al. and Yokoshima, taken individually or together.

Claims 2-6, 11, 12, 14-16 and 18-21 depend from and further limit Claim 1 and are therefore allowable over the combination of Xia et al., Ngo et al. and Yokoshima for the same reasons.

Claims 1-21 were rejected under 35 U.S.C. §103(a) as being unpatentable over the combination of Xia et al., Ngo et al., Yokoshima and Huang. Xia et al., Ngo et al. and Yokoshima were cited for the reasons described above and Huang was cited against "claims 7, 13 and 17" as teaching that "a useful form of oxygen is N_2O (col. 9, lines 59-61) in plasmas."

The Applicants do not understand this rejection. Claim 1, from which all other claims depend, contains no reference to N_2O. Thus the teaching of Huang relied on by the Examiner is inapplicable to Claim 1. As for Claims 7, 13 and 17, each of these claims is allowable over the other three cited references by reason of its dependency on Claim 1, and this is not altered by the citation of Huang.

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If the Examiner intended to cite Huang against Claim 1, they would like to know the basis of the rejection.

New Claims 22 and 23 depend from Claim 1 and are allowable for the reasons stated above. Claim 23 is supported at page 10, lines 8-11, of the specification.

New Claim 24 is allowable over the cited references for the reasons stated above. Claim 24 is supported, for example, at page 10 , lines 18-20, of the specification. Claims 25 and 26 depend from Claim 24. Claim 26 is supported at page 10, lines 8-11, of the specification.

Thus, Applicants respectfully submit that Claims 1-26 are patentable over the cited references. Reconsideration and withdrawal of this rejection is respectfully requested. Should the Examiner have any questions concerning this response, the Examiner is invited to call the undersigned at (408) 982-8200, ext. 1.

CERTIFICATE OF FACSIMILE TRANSMISSION

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